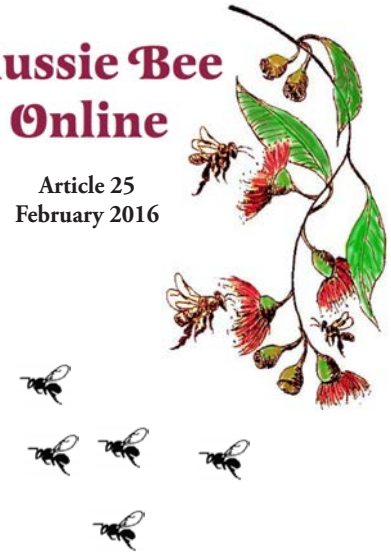
ARTICLE TWENTY FIVE

MEET THE AUSTROPLEBEIA SPECIES

– A GUIDE TO AUSSIE BEE'S REVISION PAPER

Aussie Bee Online
Article 25
February 2016



by Dr Anne Dollin
Australian Native Bee Research Centre
February 2016

THE *Austroplebeia* are a group of gentle, prettily-marked stingless bees found in northern, eastern and central parts of Australia and in New Guinea. The behaviour of these bees is fascinating but it was extremely difficult to identify their species. After investigations stretching over three decades, we have finally sorted out the species of these beautiful bees.

In November 2015, we published a 73 page scientific paper about the *Austroplebeia* stingless bees of Australia and New Guinea, in a major international journal. It was written in collaboration with Danish bee expert, Dr Claus Rasmussen.

We presented a new classification for our *Austroplebeia* stingless bees. We identified five species in Australia and New Guinea. This included one new species that we discovered and named in the Northern Territory. We also described the workers, males, queens and nests of all the species.

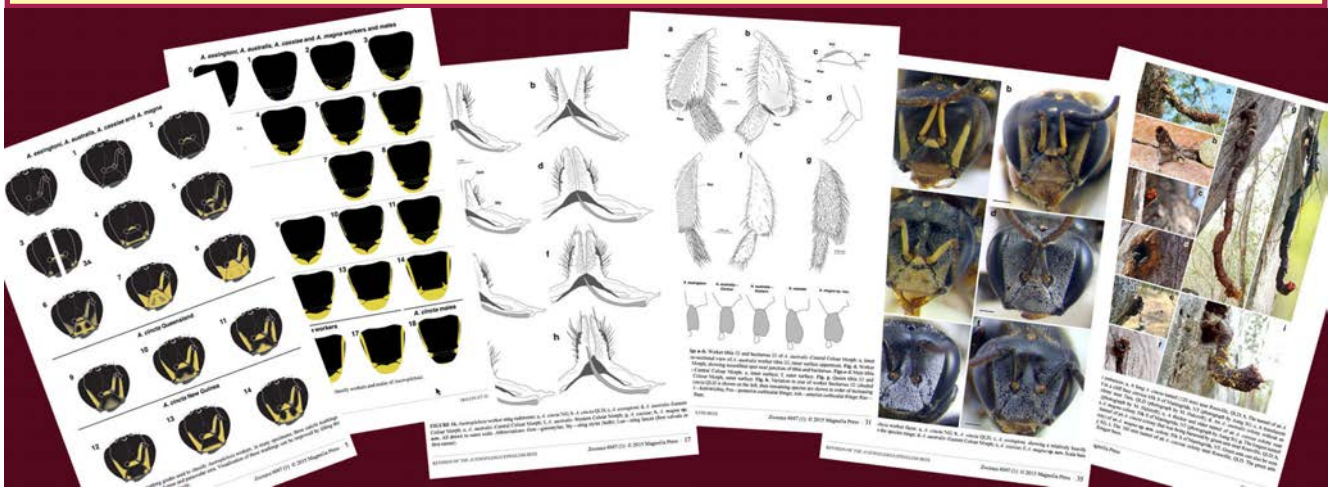
Would you just like to know the key points?

→ **See our overview of this new classification on pages 2–3.**

Would you like to read more about how the analysis was done and learn about each of the five species in detail?

→ **Read our full guide to Aussie Bee's *Austroplebeia* revision on pages 4–21.**

Our *Austroplebeia* Revision Paper:
'Australian and New Guinean stingless bees of the genus *Austroplebeia* (Hymenoptera: Apidae)—a revision' by Anne Dollin, Les Dollin and Claus Rasmussen, was published in November 2015 in *Zootaxa*, 4047: 1–73.



An Overview of the New Classification

Aussie Bee Online
Article 25
February 2016

The most popular native bees in Australia are our stingless social bees. They are divided into two groups or genera: *Tetragonula* (previously called *Trigona*) and *Austroplebeia*. However, there had long been no clear way to distinguish the species of our Australian stingless bees.

My husband, Les, and I began studying stingless bees 35 years ago. We undertook ten major native bee safaris right across the continent over the years, systematically studying all of the species of stingless bees in Australia.[1]

The *Tetragonula* Bees

Five *Tetragonula* species were identified in a paper that we wrote with Japanese expert, Professor SF Sakagami, in 1997.[2] One extra species, *T. davenporti*, was added by Dr Pierre Franck in 2004, based on a DNA study.

The *Austroplebeia* Bees

The *Austroplebeia* species proved to be far harder to classify. However, we recently managed to identify all the *Austroplebeia* species in a 2015 paper that we wrote with Danish expert, Dr Claus Rasmussen.[3] This paper was the result of three years of intensive microscope work, that we performed on bees sampled from 177 *Austroplebeia* nests right across Australia. Our work was built upon some high-tech analyses that we did with Dr Megan Halcroft and her colleagues in 2009–2011.

The colour markings of the bees turned out to be rather unreliable for distinguishing the *Austroplebeia* species. The bees' colour markings varied a great deal within the nests. Instead we found that particular leg measurements and hair patterns were more useful for distinguishing the species. More details about this will be published in Edition 3 of our Booklet 4: *How to recognise the different types of Australian stingless bees*,[4] in mid 2016.

Early entomologists had previously published nine species names for the *Austroplebeia*. Part of our task was to match up these nine old names with our current *Austroplebeia* bees. The rules for naming animals say that we must use the first name that was ever published for a particular species. If more than one name exists for a species, then only the oldest name must be used.

Below, one of our most colourful species – an Austroplebeia australis worker with a glowing orange abdomen. Photo by Dianne Clarke.

Here are our results!

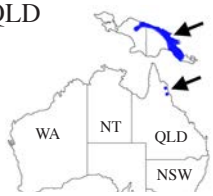
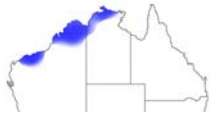
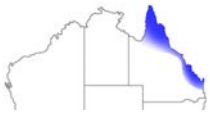
The *Austroplebeia* of Australia and New Guinea belong to five different species:

[listed from the species with the most colour markings — to the species with fewest colour markings]

- ***Austroplebeia cincta*** — named in 1898
- ***Austroplebeia essingtoni*** — named in 1905
- ***Austroplebeia australis*** — named in 1898
  Four more names were published for this species in later years: ***A. percincta, A. cockerelli, A. ornata*** and ***A. websteri.***
  Its first published name was *A. australis*. So this species should now be called *A. australis*.
- ***Austroplebeia cassiae*** — named in 1910
  One more name was published for this species 22 years later: ***A. symei.***
  Its first published name was *A. cassiae*. So this species should now be called *A. cassiae*.
- **and *Austroplebeia magna***
  a New Species that we found in the Northern Territory and named in 2015.

Right: A worker bee of the new NT species, Austroplebeia magna. This is the Austroplebeia species with the darkest colouring.

Based on our revision, there are five currently recognised *Austroplebeia* species:

Species name & length of worker	Distribution	Colouring	Remarks	More details
Austroplebeia cincta 3.5 mm	New Guinea and north QLD 	Bright yellow bands on the face and thorax. A distinctive yellow patch underneath the wing on the side of the thorax.	Elongated nest entrance tunnels. Builds a unique brood comb with the new cells waxed into concentric shells.	Pages 9–10
Austroplebeia essingtoni 3.5 mm	Northern areas of WA and NT 	Usually has broad cream markings on the face and thorax	Usually nests in small hollow trees but may nest in wall cavities or crevices in cliffs	Pages 11–12
Austroplebeia australis 4 mm	A very widespread species found in NSW, QLD, NT and WA 	In eastern and western areas of the continent the workers have two to four cream marks on the rear of their thorax. In central areas the workers are more brightly marked with additional side bands on the thorax. The workers' abdomens may be black, ochre, red or even a glowing orange.	Our data show that these bees are all the same species, despite their colour variations. Other old names for this species were: *A. percincta*, *A. cockerelli*, *A. ornata* and *A. websteri*. These four old names should no longer be used.	Pages 13–15
Austroplebeia cassiae 4 mm	Northern and eastern QLD 	Dark. The rear edge of their thorax normally just has two dull cream marks or may be completely black.	The hair on the worker's face is much denser in *A. cassiae* than in *A. australis*. In recent years, these bees were often called *A. symei*.	Pages 16–17
Austroplebeia magna 4 mm	Northern NT and far northwest QLD 	Dark. The rear edge of the thorax may have two dull cream marks. Some workers have no cream marks at all on the face or thorax.	This is a new species we found in NT. The name refers to the broad segments on this bee's hind legs: 'magna' is a Latin word for 'large'.	Pages 18–19

A full guide to Aussie Bee's *Austroplebeia* revision

Aussie Bee Online

Article 25
February 2016

Our Australian stingless bees are kept by beekeepers across the country. They make wonderful displays for teaching children, produce delicious honey, and are valuable for crop pollination. However, despite this intense interest, the species names of our stingless bees had long been in a state of chaos. There were no good descriptions of the species and no clear ways to identify them.

Back in 1980, my husband, Les, and I set ourselves the goal of sorting out all of Australia's stingless bee species. We had no idea what a huge task that would be!

We undertook ten major outback native bee safaris right across Australia, systematically visiting each place where a stingless bee species had previously been named. We explored Cape York, Arnhem Land, Central Australia and The Kimberley.[1] We searched for stingless bee nests in each area, studied nest structures and examined workers, males and queens of each variety that we found. Many Aboriginal people, station owners and beekeepers helped us in our search and we progressively learned all we could about every stingless bee species in Australia.

One of our outback native bee safaris on Cape York, in our blue Landcruiser with an extension ladder on the roof rack.

Australia's *Tetragonula* and *Austroplebeia* stingless bees

Australia's stingless bees are small, black native bees (about 4 mm long) that are found in northern, eastern and central parts of the continent. They live in social colonies containing hundreds or thousands of bees. They usually build nests inside hollow trees, but some species nest in other cavities, such as inside walls or in crevices in cliffs.

The colonies have workers, males and queens, similar to the familiar introduced European honeybees. Stingless bees make small quantities of a delicious tangy honey called 'sugarbag'. They are also valuable pollinators.

We have two groups of stingless bees in Australia. The ***Tetragonula*** bees (previously called *Trigona*) are black, with short white hair on their face and sides. The ***Austroplebeia*** bees usually have small cream or yellow markings on their face and thorax.

The *Tetragonula* Bees

In 1982, a Japanese scientist, Professor Shôichi Sakagami, offered to collaborate with us. He was an expert on the *Tetragonula* stingless bees. Together with him, we published a paper in 1997 sorting out the species names of the *Tetragonula* stingless bees.[2] Some of the *Tetragonula* species build strikingly different nest structures and these structures make it easier to distinguish between the species. Details of these findings are explained in Booklet 4.[4]

The *Austroplebeia* Bees

The *Austroplebeia* stingless bees proved to be far harder. We found few differences between their nests. There was one rather distinct species in New Guinea. However, the bees we saw in Australia only seemed to vary from dark 4 mm long varieties to more brightly marked 3.5 mm long varieties, with no obvious groups. It required years of intensive study to confidently separate these bees into species.

This goal has finally been achieved! With the help of Danish stingless bee expert, Dr Claus Rasmussen, we have just published our major scientific paper on the *Austroplebeia* species.[3] This completes our revision of all the stingless bee species in Australia.

Let's now take a look at some of the fascinating discoveries we made as we explored the *Austroplebeia* stingless bees.

The Challenging *Austroplebeia* bees

The most obvious differences between individual *Austroplebeia* bees are the tiny cream or yellow bands they have on their face and thorax. Some bees have bright, broad markings, whilst others only have tiny dull specks or even no markings at all. Some bees also have bright glowing orange abdomens, whilst others have abdomens that are reddish, ochre or black. Could any of these different colour forms be different species?

Most studies on Australian stingless bee species in the past have been based on bees collected from flowers. However, right from the beginning we based our field studies on nests of stingless bees. We recorded details of the nest structures and tried to examine 10 to 20 workers, and if possible, males and queens as well, from the same nest. Over the years we studied bees from 177 *Austroplebeia* nests. The insights we gained from these nests finally helped us understand the challenging *Austroplebeia* species.

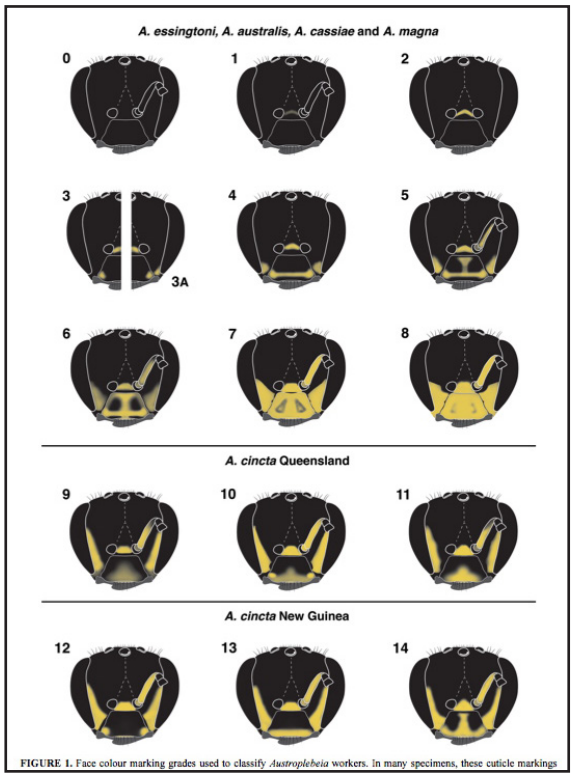


FIGURE 1. Face colour marking grades used to classify *Austroplebeia* workers. In many specimens, these cuticle markings

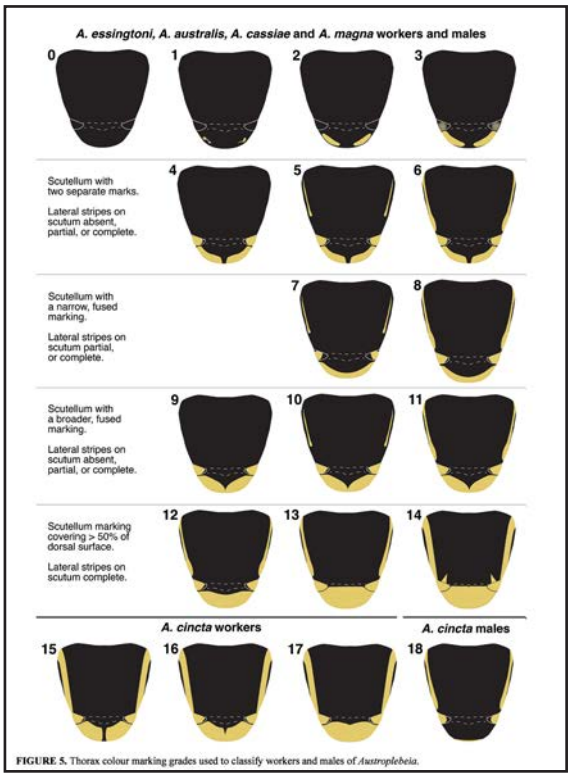


FIGURE 5. Thorax colour marking grades used to classify workers and males of *Austroplebeia*.

Far left, the full range of colour markings seen on the face in Austroplebeia workers. The white hair on the face can hide these markings, so you may need to hold the bee's face at an angle to see the markings.

Left, the full range of markings seen on the thorax in worker and male Austroplebeia bees.

We soon discovered that it was possible to find bees with a wide range of different colourings inside the same nest. You may find bees with bright markings along with dull ones, or bees with a range of different coloured abdomens. We found up to six different thorax colour variants in the same stingless bee nest! These nest-mates must belong to the same species, yet their colourings could be quite variable. We were also surprised to discover that nests with extremely dark worker bees had male bees that were very brightly marked.

Clearly we would need to be very cautious about trying to use colour differences to distinguish between the *Austroplebeia* species. Were there any other techniques which could help?

Applying modern technologies

One modern technique that has helped scientists to distinguish difficult species is a DNA analysis. In 2007 Megan Halcroft was studying the *Austroplebeia* for her PhD at the University of Western Sydney in Richmond, NSW. We agreed to begin some collaborative studies to see if DNA could help us sort out the *Austroplebeia* species. The work was technically difficult as many of our specimens were by then 20 to 30 years old. Nevertheless the results began to reveal, for the first time, the underlying relationships between our bees.

The DNA work was backed up by three other studies:
— a high-tech wing vein analysis done by Dr Tiago Francoy of São Paulo University, Brazil;
— statistical analyses of the bees' colouring; and
— electron microscope investigations of the male genitalia shape.
Slowly some consistent patterns emerged from the data and we began to see where the divisions should be drawn between these challenging species. The results of this collaborative study were published in 2015.[5]

Back to the microscope

Building on the groups suggested by the collaborative work with Megan and her colleagues, I then embarked on a three year intensive microscope examination of our entire *Austroplebeia* collection.

The bee samples that we had collected from nests were crucial to the success of our work. These Australian stingless bees are extremely difficult to classify because they show so few differences between the species in size, colour or shape. By studying samples from nests, we learned how variable the colour patterns are in these species and we were able to find more reliable features that distinguished the species. We also were able to confidently match workers, males and queens for each species, and find additional distinctions between the species from all three castes. This would have been far more difficult or impossible using bee samples collected from flowers.

Painstaking comparisons slowly revealed a number of features that were far more reliable than the colour markings for distinguishing the *Austroplebeia* species. These included:

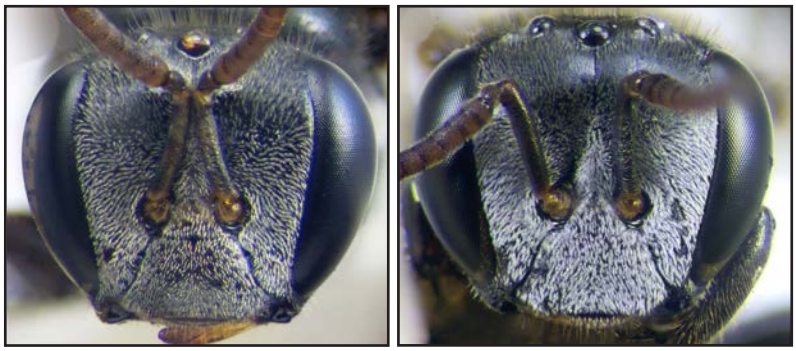
In workers:
— the width of a hind leg segment called the basitarsus (shown on right)
— the colour of the bristles inside the hind basitarsus
— the thickness of the hair on the face (shown below)

In males:
— the shape of the feathery hairs on the side of the thorax
— features of the male genitalia

In queens:
— the number of segments with dense hair on the top of the abdomen

More details about how these features can be used to distinguish the *Austroplebeia* species will be published in Edition 3 of Booklet 4: *How to recognise the different kinds of Australian stingless bees*,[4] in mid 2016.

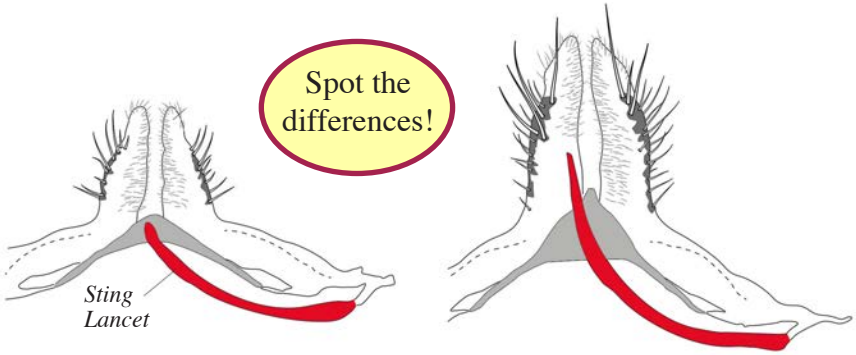
Above: The hind leg of an A. magna worker. The arrow indicates the basitarsus segment.



Left: The faces of an A. australis worker (on the left) and an A. cassiae worker (on the right).

The white hair is much denser in A. cassiae than it is in A. australis.

A tiny structure in the workers called the 'sting rudiment' provided further support for the species distinctions we were seeing. Even though these *Austroplebeia* bees are 'stingless', a minute remnant of the sting structure still exists inside the tip of the abdomen of the worker bees. The entire structure is only half a millimetre wide and has to be examined under a high powered microscope. Measurements of minute features of the sting rudiments confirmed the identities of our *Austroplebeia* species.



The sting rudiment structure of A. essingoni (on left) and A. magna (on right) shown at the same magnification. There are large differences in the shape of various features of this structure between the two species. In particular, the sting lancet (shown in red) is much longer in A. magna than it is in A. essingtoni.

The species *A. cincta* is mainly found in New Guinea, although we recently identified and studied two small populations of it in North Queensland. To build a good description of the New Guinea population, analyses were done of specimens that we found in various museums in Australia and in London.

Matching up the names

By combining all this information, we concluded that there were five different *Austroplebeia* species in Australia. However, what were the correct names of these species? The international rules for naming animals say that we must use the oldest name that has ever been published for each species.

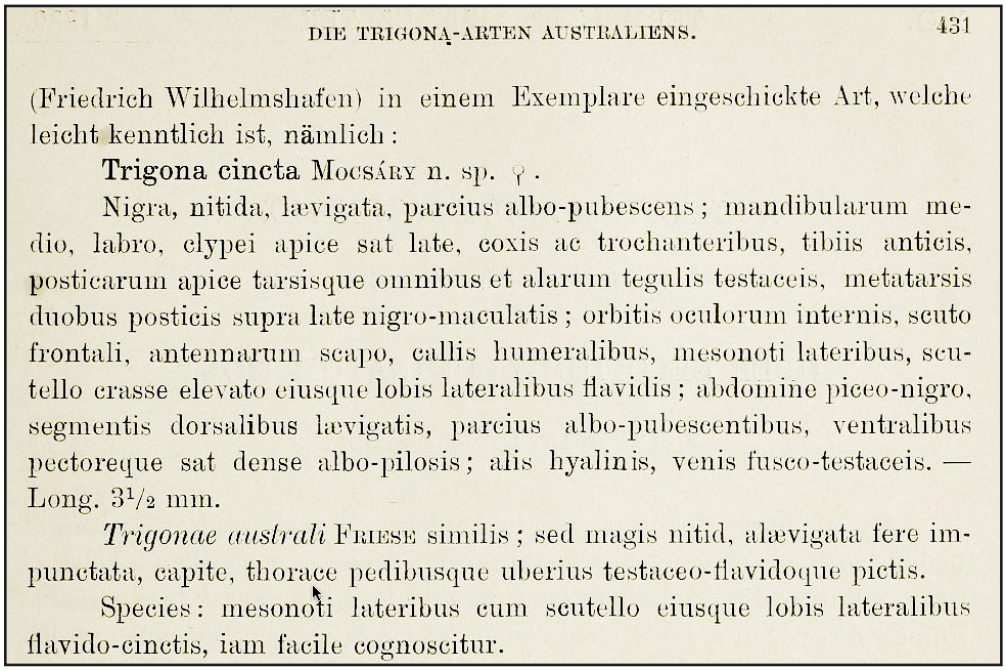
Naturalists have been interested in the *Austroplebeia* for nearly 200 years. Two worker bees were collected at Port Essington on the far north coast of Arnhem Land, NT, in about 1840. These bees, sent to London on a wooden sailing ship, became the first described specimens of the species, *Austroplebeia essingtoni*.

The British outpost called Victoria Settlement at Port Essington, NT, in 1846. The original specimens of Austroplebeia essingtoni were collected here in about 1840. Artist: Louis le Breton.

During the following 90 years, other *Austroplebeia* bees were collected in isolated parts of Australia and New Guinea. They were sent to museums or directly to entomologists for examination. Eventually nine *Austroplebeia* species names were published based on these old specimens. The next task was to match these nine old species names up with our five current *Austroplebeia* species.

When more than one species name has been published for a particular group of bees, the rules say that the oldest name must be used. The more recent names are called 'synonyms' and should not be used any more.

For each old species name, there are usually two sources of information. Firstly, the entomologist who named the species should have published a description of the bee. We had to find these descriptions in old scientific journals dating back to 1898. Some of the *Austroplebeia* descriptions were detailed, but one was just a few words. One was written in German and another was written in Latin! Unfortunately all the descriptions concentrated on the bees' colour markings, that our studies have shown to be quite unreliable in the *Austroplebeia*. So these were not going to be much help!



DIE TRIGONA-ARTEN AUSTRALIENS. 431

(Friedrich Wilhelmshafen) in einem Exemplare eingeschickte Art, welche leicht kenntlich ist, nämlich:

Trigona cincta Mocsáry n. sp. ♀.

Nigra, nitida, lævigata, parcius albo-pubescens; mandibularum medio, labro, clypei apice sat late, coxis ac trochanteribus, tibiis anticis, posticarum apice tarsisque omnibus et alarum tegulis testaceis, metatarsis duobus posticis supra late nigro-maculatis; orbitis oculorum internis, scuto frontali, antennarum scapo, callis humeralibus, mesonoti lateribus, scutello crasse elevato eiusque lobis lateralibus flavidis; abdomine piceo-nigro, segmentis dorsalibus lævigatis, parcius albo-pubescentibus, ventralibus pectoreque sat dense albo-pilosis; alis hyalinis, venis fusco-testaceis. — Long. 3½ mm.

Trigonae australi Friese similis; sed magis nitid, alævigata fere impunctata, capite, thorace pedibusque uberius testaceo-flavidoque pictis.

Species: mesonoti lateribus cum scutello eiusque lobis lateralibus flavido-cinctis, iam facile cognoscitur.

Can you read this?

The original desription of the species, Austroplebeia cincta, written in Latin by Alexander Mocsáry in 1898.

Secondly, one or more of the original bees (or 'type specimens') examined by the entomologist should be stored somewhere in a museum. In Australia's earlier years, most scientific specimens were sent overseas for examination and storage. Amongst the nine sets of *Austroplebeia* type specimens, two had been sent to England, two to Germany and one to Hungary. Examining these fragile old specimens on the other side of the world would also be a challenge!

At this point I received a wonderful offer from the Danish stingless bee expert, Dr Claus Rasmussen. Due to his keen interest in historic bee specimens, Claus had already located and studied the original *Austroplebeia* type specimens. Would I like copies of his photographs and measurements? I was delighted to accept!

Claus' data and photographs were a huge help. However, these were old specimens, collected up to 170 years ago. Some had missing heads or legs, and many were contaminated and/or discoloured. Nevertheless after much arduous work, we managed to match each old type specimen with our current *Austroplebeia* bees.

Dr Claus Rasmussen (shown above) located original Austroplebeia type specimens in five different museums in Australia, UK and Europe. His photographs and measurements on these specimens were invaluable for our revision paper. Centre, the original handwritten label saying 'Port Essing-ton' from one of the two Austroplebeia essingtoni type specimens collected in about 1840 and the face of the other specimen. These bees are in the collection of the Natural History Museum of London, shown in the background.

Our conclusion – the revised species names

From all of these studies, we concluded that there were **five *Austroplebeia* species in Australia and New Guinea:**

— **Four species already had old names** which had been given to them by earlier entomologists: *A. cincta*, *A. essingtoni*, *A. australis* and *A. cassiae*. Two of these had additional old names, that should no longer be used.

— **One was a new species** which we named *Austroplebeia magna*.

***Austroplebeia* species**	**Oldest species name**	**Other species names which should no longer be used**
Austroplebeia cincta	*A. cincta* (Moscáry, 1898)	—
Austroplebeia essingtoni	*A. essingtoni* (Cockerell, 1905)	—
Austroplebeia australis	*A. australis* (Friese, 1898)	*A. percincta* (Cockerell, 1929) *A. cockerelli* (Rayment, 1930) *A. ornata* (Rayment, 1932) *A. websteri* (Rayment, 1932)
Austroplebeia cassiae	*A. cassiae* (Cockerell, 1910)	*A. symei* (Rayment, 1932)
Austroplebeia magna	—	—

Aussie Bee Online
Article 25
February 2016

Meet the *Austroplebeia* species!

Now let me introduce you to the five *Austroplebeia* species:

Austroplebeia cincta

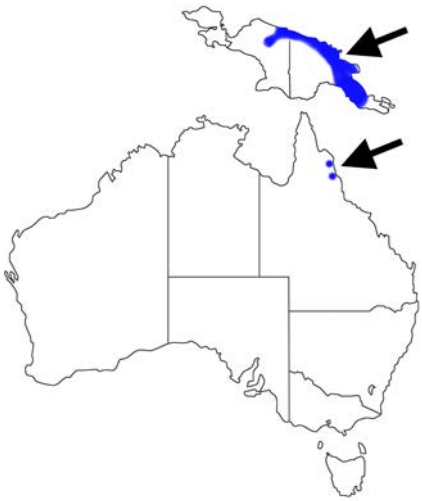
Worker body length: 3.3–4.2 mm in New Guinea, 3.0–3.5 mm in Australia

The outstanding Hungarian field entomologist, Lajos Biró, collected the first specimen of *A. cincta* near Friedrich Wilhelmshafen (now known as Madang, Papua New Guinea) in 1896. It was sent to a museum in Budapest, Hungary. The museum curator, Alexander Mocsáry, described this species in Latin in 1898 (see the copy of this description on page 7).

A. cincta is mainly found in New Guinea. It was quite a challenge to discover the distribution of this species there. Many of the rare specimens that we found in museums came from obscure localities, such as Mafulu, Njau-limon, Upper Jimi and Mulik River. My husband, Les, spent a week at the National Library in Canberra searching for these New Guinea villages and rivers on old maps and journals published before the Second World War. We will bring you some of the fascinating stories that Les discovered about early collection expeditions to New Guinea in a future *Aussie Bee Online* article.

Finally we worked out where *A. cincta* had been found in New Guinea (see map). A few years ago, we also identified *A. cincta* in two small populations (marked by the arrow) in the Daintree and Atherton Tablelands areas of North Queensland. These are all areas with high annual rainfall.

These small but spectacular bees have bright yellow bands on their face and thorax ('cincta' is a Latin word for 'bordered'). Workers also have a distinctive yellow patch underneath the wing on the side of the thorax (shown below). Unlike all other *Austroplebeia* species, the males of *A. cincta* are darker than the workers, lacking some of the thorax markings seen in the workers.



Estimated current distribution of Austroplebeia cincta

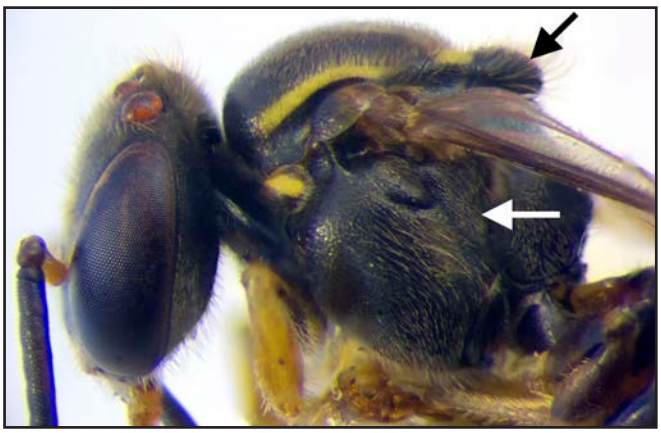
WORKER

The worker's face (shown on the left) is from a New Guinea bee. In QLD the workers have slightly duller markings.

Workers have a distinctive yellow patch under the wing (shown with arrow).

MALE

*Notice that the male **lacks** two of the yellow markings seen in the worker: the band on the rear edge of the thorax and the marking underneath the wing (shown with arrows)*



A. cincta, continued...

In 2012 we spent a marvellous month in tropical north Queensland studying the nests and behaviour of this beautiful species, with the kind help of the Roberts family. *A. cincta* bees are remarkable tunnel builders. Flying foragers are harassed by aggressive green ants in these areas. So the bees build elongated nest entrance tunnels. They extend the tunnel, longer and longer, by adding sticky resin to its tip. Finally the tunnel collapses under its own weight and the bees immediately get to work on constructing a new tunnel. One exceptional tunnel we saw was 43 cm long!

See Aussie Bee's video about the amazing tunnels built by *A. cincta*, here:
www.aussiebee.com.au/video-stingless-bees-4.html

Nest structures of A. cincta. Top right, a typical nest entrance tunnel (12 cm long) of A. cincta in QLD. Left, an extremely long A. cincta tunnel (43 cm) in QLD. Lower centre, the batumen shells enclosing a QLD A. cincta nest (Bat = batumen). Lower right, new brood cells waxed into irregular concentric shells in an A. cincta nest.

Nests are built in the cavities of quite large trees (35 cm or larger diameter in New Guinea,[6] and 22–80 cm diameter at nest level in QLD). The bees create a suitably-sized space for the nest by closing off part of the cavity with heavy black batumen walls.

This is the only *Austroplebeia* species that does not build a brood with a cluster structure (see *A. essingtoni* section below). Instead the new brood cells are waxed into irregular, single-layer, concentric shells. The honey and pollen are stored in fragile, spherical or oval shaped pots.

To read more about our *A. cincta* discoveries in QLD, see *Aussie Bee Online* Articles 22 and 23:
www.aussiebee.com.au/abol-current.html

Also watch Aussie Bee's video showing an *A. cincta* queen laying an egg in the brood, here:
www.aussiebee.com.au/video-stingless-bees-7.html

Aussie Bee Online
Article 25
February 2016

Austroplebeia essingtoni

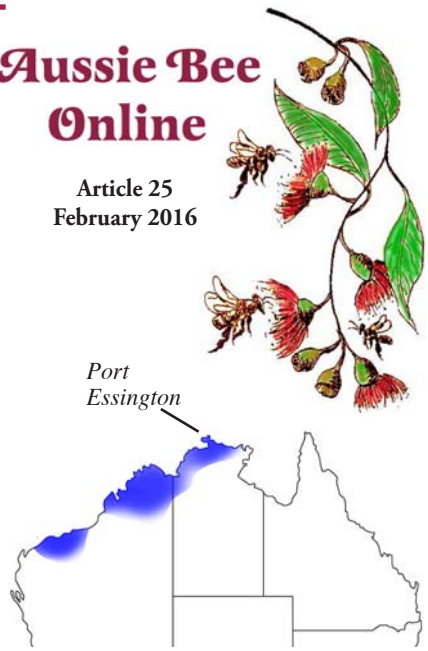
Worker body length: 3.2–3.9 mm

The earliest specimens of this species were collected from Port Essington on the north coast of Arnhem Land, NT, in about 1840. At that time a tiny British outpost, in that remote place, was struggling to survive against the perils of isolation and a great hurricane. The outpost had a set of canons on the cliff to defend Australia's northern coastline.

The Port Essington bee specimens were sent to England and were purchased by the Natural History Museum in London in 1842. Professor TDA Cockerell, an American bee expert, examined them there six decades later. He described them as a new species in 1905, naming them after place where they were collected.

These workers usually have distinct cream bands on the side and rear of the thorax and broad cream markings on the lower face. Most workers are noticeably smaller than those of the other *Austroplebeia* species in their range.

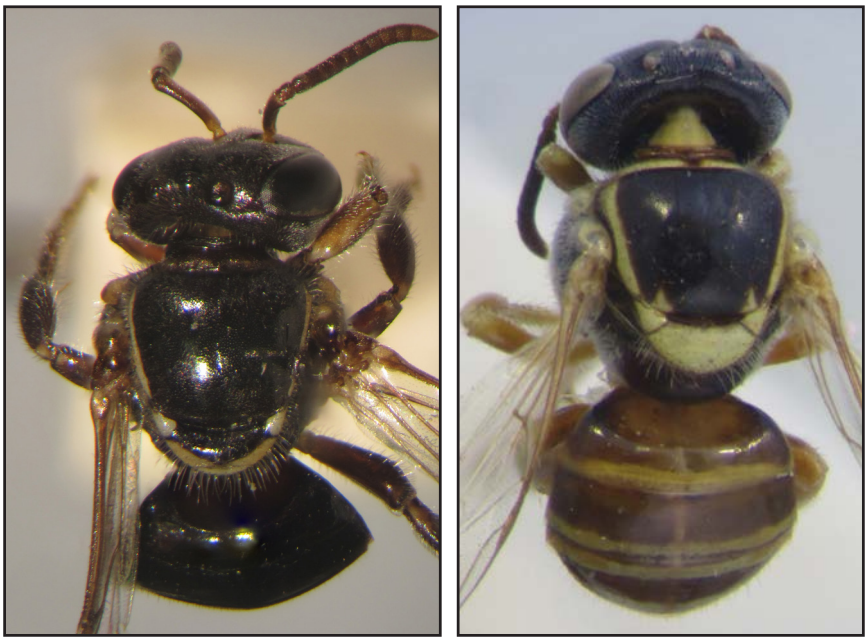
However, their colouring varies. Workers in the Hamersley Ranges were the most brightly marked, with pale yellow bands on the thorax, legs and abdomen, and bright patterns on the lower face. In other populations such as in some coastal areas, the workers were much darker as shown in the photographs below.



Estimated current distribution of Austroplebeia essingtoni

Below left, a very dark and a very bright example of the colour markings seen in A. essingtoni workers. Below right, the males of A. essingtoni are all brightly marked. The males have genitalia with bent tips (shown with arrows).

WORKER



MALE

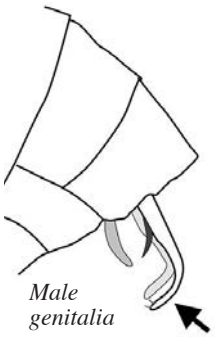
Aussie Bee Online
Article 25
February 2016

Left, Les Dollin searches for bee nests in the 150 year old ruins of stone cottages at Port Essington, NT

In 1987 we visited Port Essington to search for this species where it had been originally collected. We were amazed to see stone ruins of the cottages built by those early British settlers, nearly 150 years earlier, still standing in the bush. Tiny nests of *Tetragonula mellipes* filled many crevices in the stonework. However, no *Austroplebeia* were to be seen.

It required a week of persistent searching before we finally discovered two nests of *A. essingtoni* in spindly dead trees in the surrounding bush. Tiny stripy bees peeked out of elaborate nest entrance tunnels. One tunnel had a curly leaf incorporated into it, and the other had a second, closed-off tunnel hanging underneath it. With much excitement we examined these *A. essingtoni* bees from the place where they had first been found back in 1840.

On an earlier native bee safari through the spectacular Hamersley Ranges in WA, we had found some similar tiny stripy *Austroplebeia* bees. However, these nests were a huge distance from Port Essington in NT – about 2000 km! Could they be the same species?



Male genitalia

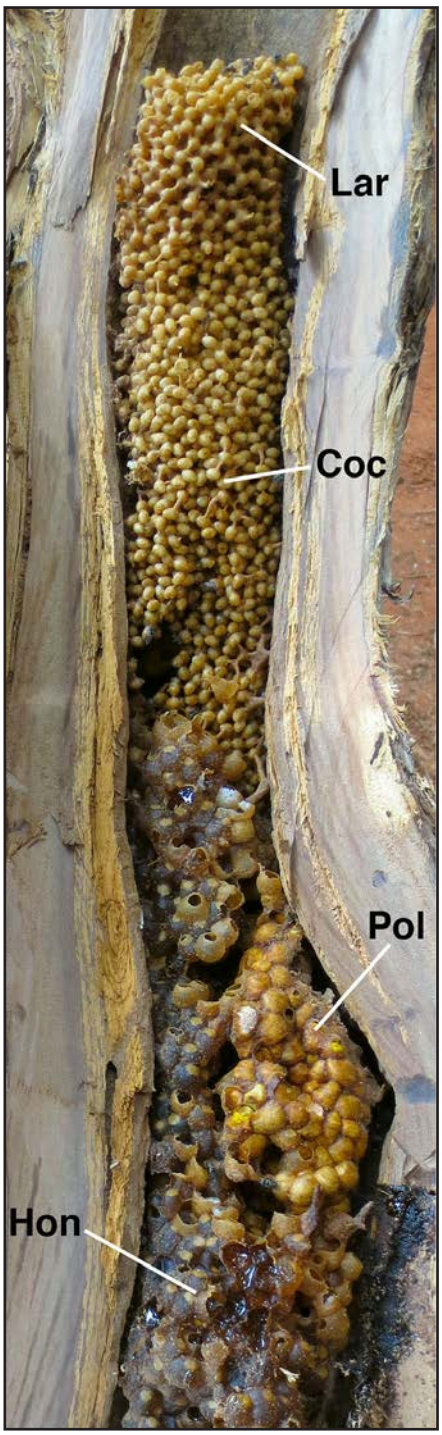
Studies with Megan Halcroft later revealed that males from these nests in NT and WA all had unusual bent tips on their genitalia. These tips can often be seen in dried bees protruding from the end of their abdomen (as shown in the drawing on the left – compare with drawing on page 18). This was good evidence that they were all the same species.

The in-depth surveys we recently completed for our revision paper revealed that the species, *A. essingtoni*, is in fact widely distributed in northern areas of WA and NT: in the Hamersley Ranges, The Kimberley and in Arnhem Land. They can survive in some quite arid areas with annual rainfalls down to 300 mm.

Nests are normally built inside small to medium hollow trees (9–30 cm diameter at nest level). However, this was the only *Austroplebeia* species which we found nesting in wall cavities or in cliff crevices. The bees usually build a short nest entrance tunnel.

In the brood, the spherical waxy cells (that contain the larvae) are loosely connected together into an irregular structure called a 'cluster'. The honey and pollen is stored in spherical or oval shaped pots with thin walls.

Below, the entrance tunnel of an A. essingtoni colony that has built in a cliff crevice. Photo by Aung Si. Right, a nest of A. essingtoni in a hollow tree, showing the cluster brood structure and the fragile storage pots. Lar = larvae, Coc = cocoons, Hon = honey pots, Pol = pollen pots. Photo by Tim Heard.



Aussie Bee Online

Article 25
February 2016

Austroplebeia australis

Worker body length: 3.3–4.9 mm

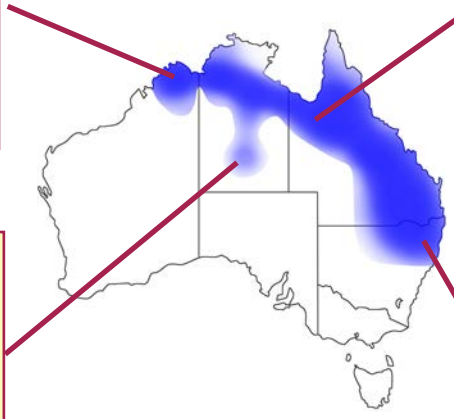
The earliest specimens of *A. australis* were collected in Central Australia in about 1891. The bees were labelled with the name of Ferdinand von Müller, the Government botanist of Victoria. However, it is thought that the missionary Adolf Hermann Kempe from Hermannsburg Mission, west of Alice Springs, NT, actually arranged the collection of these bees with the help of local Aboriginal people.

Many of the bees were sent to museums in Germany. Heinrich Friese, a German bee expert, examined numerous specimens then held by the Museum of Stuttgart, when he described this species in 1898. The species name refers to the bees' origin in Australia ('australis' is Latin for 'of the south').

A. australis is the *Austroplebeia* species that is most frequently kept in hive boxes in QLD. However, our studies show that this is actually a very widespread species, also found in NSW, NT and WA. This is the *Austroplebeia* species that extends furthest south in Australia. It has been found as far south as Dungog and Wootton in NSW (latitude 32.4° S). In central parts of Australia, *A. australis* can cope with quite arid conditions, with annual rainfalls down to 300 mm.

In WA we found an A. australis population in the forests of The Kimberley. The workers resembled those of NSW in their colouring. Josephine Cardale's bees in the Australian National Insect Collection showed that this variety could be found right up into northwestern areas of The Kimberley, on Mitchell Plateau.

In western QLD we discovered populations of striking bees with glowing orange abdomens, in dry areas such as Cloncurry, Croydon and Hughenden. Many workers also had tiny cream side stripes on their thorax.

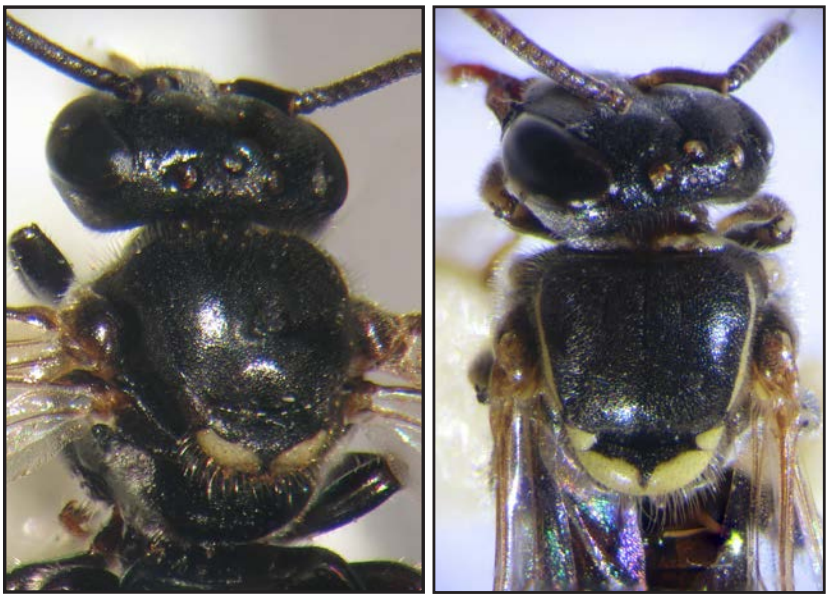


Estimated current distribution of Austroplebeia australis

In Central Australia most workers had strong thorax side stripes and black abdomens. The nests were surviving in scrubby parched areas, with small soaks and dry watercourses. Hermannsburg Mission, near where the A. australis type specimens are believed to have been collected, was in arid terrain such as this.

We first encountered A. australis right back in 1980 in northern NSW. Colonies thrived near Kempsey in coastal woodlands studded with grass trees. The workers usually just had two or four cream spots on the rear edge of the thorax, and no side stripes on their thorax.

Bees in eastern, central and western parts of Australia differ markedly in their colouring, as explained on the map. Nevertheless they all belong to the same species, because their characteristics change gradually from one local population to the next, right across the continent.



The range of thorax colour markings seen in A. australis workers:

Right, a worker from NSW with only two colour markings on the rear edge of the thorax;

Far right, a worker from Central Australia, NT, with broad cream markings on the sides and the rear edge of the thorax.

Aussie Bee Online
Article 25
February 2016

WORKER

MALE

The white hair on the worker face is finer in A. australis than it is in A. cassiae. (Compare with the A. cassiae worker photo on page 16.)

A colourful A. australis worker with a bright orange abdomen. Photo by Dianne Clarke.

A. australis males are all brightly marked, with cream bands on the face, thorax and legs. The tips of their genitalia curve gently (similar to the drawing on page 18) and can easily be distinguished from those of *A. essingtoni* males.

These attractive bees were popular with early collectors and four additional species names were published between 1929 and 1932 for these bees. However, our analyses show that they are all the same as the *A. australis* species:

— *A. percincta* (from Hermannsburg, NT),
— *A. cockerelli* (from Borroloola, NT),
— *A. ornata* (from Cape York, QLD), and
— *A. websteri* (from Wyndham, WA)

These four species names were published three decades after the publication of the *A. australis* name. The rules for naming animals say that we must use the oldest name that has been published for a species. So these four names should no longer be used and we need to call all of these bees *Austroplebeia australis*.

A. australis, continued...

The nests of *A. australis* are similar to those of *A. essingtoni*. Nests were found in trees of various sizes (8–90 cm diameter at nest level).

In eastern areas of the continent, the bees built relatively large nests in broader tree cavities (average 10 cm diameter), and most colonies built a short nest entrance tunnel.

In central areas, smaller nests were built in narrower tree cavities (average 5 cm diameter), and most colonies had no tunnel at all, with at most a smear of resin around the entrance.

This species builds a cluster brood comb and food storage pots, similar to those of *A. essingtoni*. However, the storage pots are sometimes heavily reinforced with many waxy deposits, making them appear pitted.

Top left, a translucent fresh tunnel of an A. australis colony. Photo by Megan Halcroft.

Above, an A. australis colony without an entrance tunnel. Photo by Megan Halcroft.

Top right, the cluster brood comb in an A. australis nest.

Right, thickened honey pots with a pitted appearance in an A. australis nest. Photo by Megan Halcroft.

Austroplebeia cassiae

Worker body length: 3.4–4.5 mm

In the late 1800s, two brothers, Rowland and Gilbert Turner, collected bees in the Mackay area of QLD for 18 years, resulting in the discovery of 97 new species. They collected the first *A. cassiae* specimen at Mackay, QLD, in 1899.

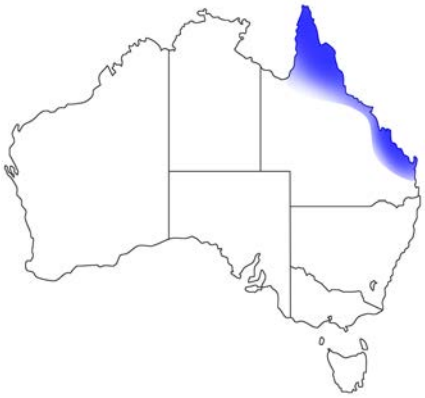
The specimen was sent, with many others, to the Natural History Museum in London. Professor TDA Cockerell described this species in 1910. He named it after the *Cassia* flowers from which the type specimen had been collected.

A. cassiae workers are generally very dark but those in our study always had at least a small, dull, crescent-shaped marking between the antennae on the face, hidden under the white hair. The rear edge of the thorax normally has just two small, dull markings or it is completely black. As in *A. australis*, the males are brightly marked and have gently curving tips on their genitalia (similar to the drawing on page 18).

Natural colonies were only found in relatively high rainfall parts of QLD (annual rainfall above 600 mm). This is the second most common *Austroplebeia* species that is kept in managed hives.

In recent years, beekeepers have been calling these QLD bees *A. symei* — a species name that was published in 1932. However, our analyses show that *A. symei* is the same as the older species, *A. cassiae*. The rules for naming animals say that the older name must be used, so we now should call these bees *Austroplebeia cassiae*.

Professor CD Michener once suggested that *A. cassiae* was the same as the species *A. australis,* on the basis of their mandible colours.[6] Our analyses show, however, that these are two separate species. *A. cassiae* has consistently thicker hair on the face, a broader hind basitarsus leg segment, and darker basitarsus bristles than *A. australis*. The colouring of the mandibles is variable in both species.



Estimated current distribution of Austroplebeia cassiae

WORKER

Notice the thick white hair on the face of the A. cassiae worker.

MALE

Males of A. cassiae are very brightly marked with cream or yellowish bands on the face, thorax and legs, even though the workers are very dark.

Aussie Bee Online

Article 25
February 2016

Les Dollin (on left) and Anne Dollin visiting Ernie Adams on his property in Central QLD to study his fascinating population of A. cassiae and A. australis

In 1987 we came across a property in central QLD that was rich in both *A. cassiae* and *A. australis*. The property owner, Ernie Adams, was an expert at finding bees. He used to collect bees four decades earlier for Tarlton Rayment. With Ernie's help, we documented 11 nests of *A. cassiae* and 12 nests of *A. australis* on his property. Even though the nests were all close together in the same paddocks, they maintained their distinct characteristics, showing that they are separate species. Later Megan Halcroft confirmed the species identity of nine of these colonies with her DNA analyses.

A. cassiae is very common on Cape York Peninsula, QLD. Les and I spent our honeymoon studying stingless bees on the tip of Cape York. Long *A. cassiae* nests filled the cavities inside many narrow dead trees and colourful males were abundant.

We found nests of this species in trees of various sizes (9–37 cm diameter at nest level). *A. cassiae* builds relatively large nests that usually have a short entrance tunnel. However, as in other *Austroplebeia* species, the bees may build elongated entrance tunnels if they are being harassed by green ants. The brood structure and storage pots are similar to those of *A. australis*.

Upper left, a typical short nest entrance tunnel of an A. cassiae colony. Lower left, the elongated nest entrance tunnel (16 cm long) of an A. cassiae colony that was being harassed by green ants. Right, the cluster brood comb of an A. cassiae colony kept in a box.

Aussie Bee Online

Article 25
February 2016

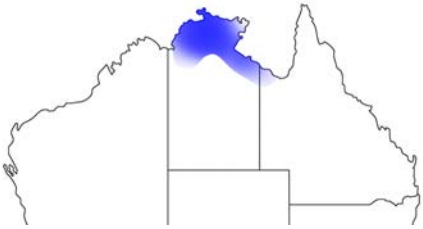
Austroplebeia magna

Worker body length: 3.5–4.5 mm

In 1987 Les and I set out on a native bee safari to Port Essington in Arnhem Land, NT, to look for the species *A. essingtoni* where it was originally collected. We set up a bush camp near the glittering blue Arafura Sea, amid wandering banteng cattle and salt water crocodiles. The shy *A. essingtoni* eluded us for many days, but meanwhile Les discovered nests of a larger dark *Austroplebeia* bee. Although these dark bees were not the goal of our safari, we still systematically studied them and carefully stored away some samples. This was most fortunate, because our recent analyses revealed that they were actually a brand new species!

Anne Dollin examining a nest in Arnhem Land in 1987. This colony was later found to belong to the new species, A. magna.

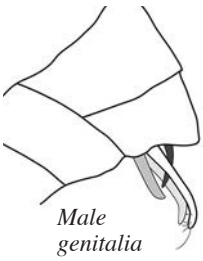
During this safari, we also found other nests of these dark bees further south, near Katherine, NT. We chose worker and male bees from one of these nests for the type specimens. We described this new species in our *Austroplebeia* revision paper in 2015.[3]



Estimated current distribution of Austroplebeia magna

A. magna workers are usually large and quite dark. Many workers had two dull cream marks on the rear edge of their thorax. However, some northern workers were the only *Austroplebeia* bees we found in our study that had no cream markings at all on their face or thorax.

A. magna males are brightly marked, with cream bands on the face, thorax and legs. As in *A. australis* and *A. cassiae*, the tips of their genitalia are gently curved (as shown in the drawing on the right and marked with the arrow in the photo below).



Male genitalia

WORKER

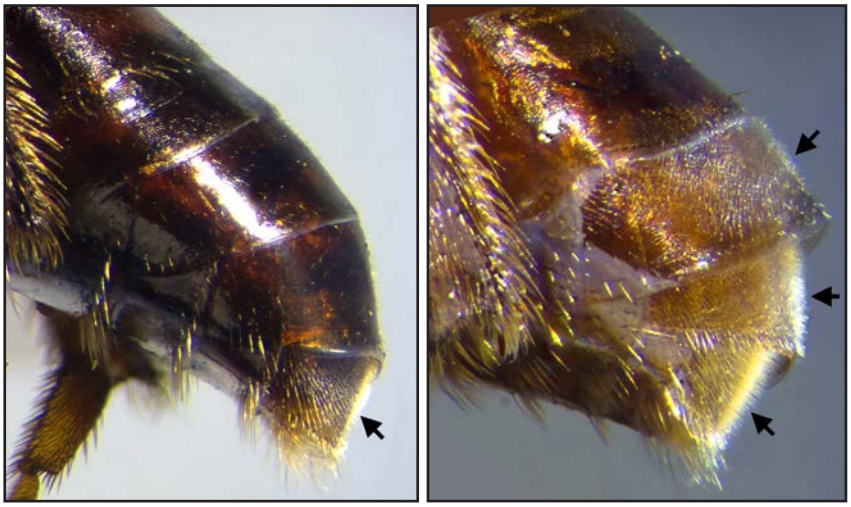
Some A. magna workers had no cream markings and were the darkest seen in the study. Others had small dull marks on the face and the rear of the thorax

MALE

Males of A. magna are very brightly marked with cream or yellowish bands on the face, thorax and legs, even though the workers are very dark. Arrow indicates gently curved male genitalia.

A. magna, continued...

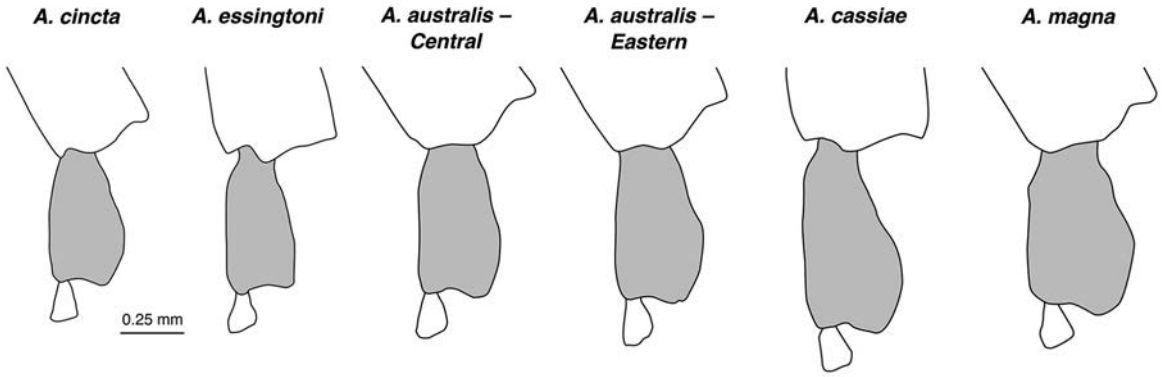
A. magna workers look quite similar to those of the QLD species, *A. cassiae*, but a surprising discovery showed us that *A. magna* and *A. cassiae* were separate species. Queens usually show relatively few differences between species. However, we found a very clear-cut difference between the queens of these two species, in the hair patterns on their upper abdomens:



Far left, the queen abdomen of A. magna only has a single segment covered with dense short hair (arrow).

Left, The queen abdomen of A. cassiae has three segments covered with dense short hair (shown with arrows).

In some workers of this species, the basitarsus segments on the hind legs (see photo on page 6) were the broadest seen in the study. In addition, in our study of the worker sting rudiments (see drawing on page 6), this species had the longest sting lancet. So we named this new species, *Austroplebeia magna* ('magna' is a Latin word for 'large').



Variation seen in the size of the basitarsus segment on the hind leg in Austroplebeia workers.

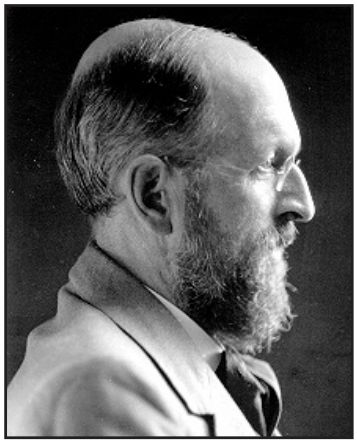
A. magna had the broadest basitarsus.

A. magna is mainly found in northern parts of NT but we have traced its range along the southern shores of the Gulf of Carpentaria and a short distance into western QLD. Its distribution was in areas with an annual rainfall of more than 600 mm.

All nests that we studied of *A. magna* were in small to medium sized hollow trees (10–24 cm diameter at nest level). The bees usually built a short nest entrance tunnel. The brood structure and storage pots were similar to those of *A. australis*.

Below left, a typical short nest entrance tunnel of an A. magna colony. Below right, the cluster brood of an A. magna colony within a narrow hollow in a tree. Photos by Aung Si.

Conclusion



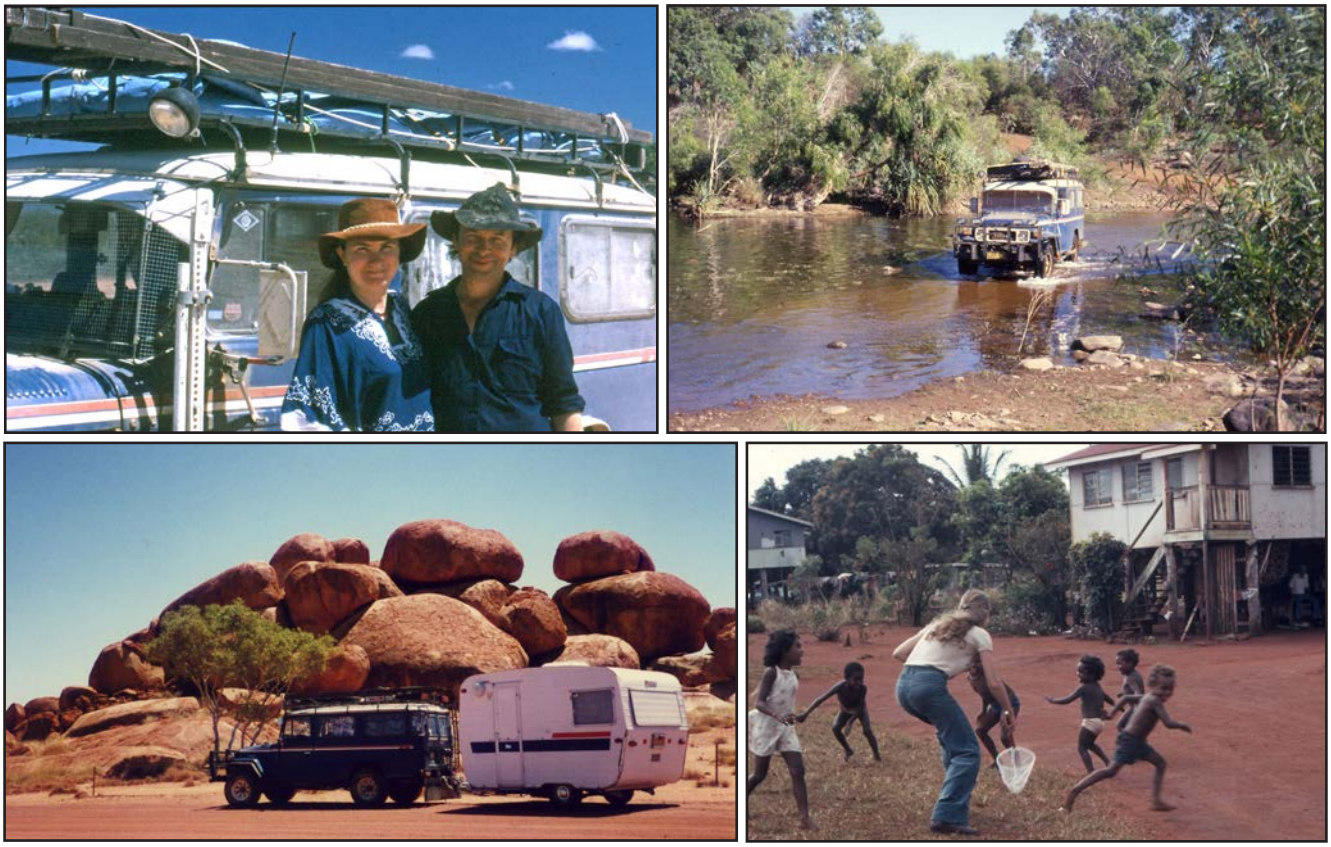
Professor TDA Cockerell

Professor TDA Cockerell of the University of Colorado, USA, (1866–1948) was a remarkable entomologist who described over 6,000 bee species worldwide, including *Austroplebeia essingtoni* and *Austroplebeia cassiae*. In 1930 in a review paper on Australian native bees,[7] he wrote,

'If I may express a personal wish in relation to Australian bees, it is that I may live to see some young student, man or woman, take up the study in Australia and have sufficient perseverance and skill to carry it far beyond the present stage.'

We hope that, for the stingless bees of Australia, we have in some measure fulfilled Professor Cockerell's wish.

The *Austroplebeia* research explained in this article, along with our studies of the *Tetragonula* species, have been a major focus for my husband, Les, and myself during the past 35 years. The work was based on our studies of bees from 192 *Tetragonula* nests and 177 *Austroplebeia* nests, throughout the known range of these bees in Australia. This was supplemented by studies of bee collections in museums in Australia and overseas.



Scenes from our native bee safaris. Top left, Anne and Les Dollin with their Landcruiser on the road in 1990; Top right, crossing a creek in the Gulf of Carpentaria in 1987; Lower left, through the 'Red Centre', NT, in 1996; Lower right, Anne playing with local children from a community on Cape York Peninsula, QLD, in 1983 — the children had been showing us stingless bee nests in the area.

Our work has been generously supported by many native bee enthusiasts, Australian bushmen, Aboriginal people, and by museum and scientific colleagues, in particular Professor Shôichi Sakagami, Dr Megan Halcroft and Dr Claus Rasmussen.

The stingless bees of Australia bring great enjoyment to thousands of beekeepers across Australia. Children love watching these cute and captivating bees, and thereby learn to respect and protect our native wildlife. The use of these bees in niche honey production and in pollination will continue to expand as the number of managed hives in Australia grows. We hope that our revision papers on the *Tetragonula* and *Austroplebeia* species will assist ongoing research into these valuable and fascinating Australian native bees.

Aussie Bee Online
Article 25
February 2016

Acknowledgements

These stingless bee studies would not have been possible without the help of numerous native bee enthusiasts, beekeepers, station owners and Australian bushmen who helped us find stingless bee nests, sent us bee samples, and provided valuable information about the bees and their behaviour. We extend our thanks to you all! However, in particular we wish to thank the following people who provided us with special assistance: Ernie Adams, Allan Beil, Dianne Clarke, Peter Davenport, Cec Heather, Rob Raabe, Bob Raymond, and Lewis, Edith and Charlie Roberts. Our friends, Juel and Ross Craig, also provided wonderful support during our 2012 North Queensland safari, loaning us their Landcruiser and camper trailer.

Aboriginal people, elders and specialists from many northern Australian communities assisted us in our field work and explained the indigenous names for the stingless bee species of their regions. We greatly appreciate their help.

Many scientists and researchers supported our work too, generously providing advice, information, photographs and bee samples. We warmly thank: Michael Batley, Kingsley Dixon, Wendy Forno, Tiago Francoy, Victor Gonzalez, Megan Halcroft and her University of Western Sydney colleagues, Tim Heard, David Notton, Aung Si, Myfany Turpin and Ken Walker. We also appreciated the support that was provided in earlier years by the late Professors Shôichi Sakagami and Charles Michener.

Nine museums within Australia and overseas allowed us examine their bee collections. We thank the museum curators for their support. Derek Smith and David Britton of the Australian Museum also helped us arrange loans of *Austroplebeia* specimens.

The Wheen Bee Foundation generously loaned us an excellent compound microscope that was vitally needed for our analyses.

Les Dollin discussing native bees with bushwalkers in Central Australia. These were amongst the hundreds of native bee enthusiasts who assisted our work.

Finally, a special thank you goes to our co-author, Claus Rasmussen. His analyses of the original type specimens, held in museums throughout the world, provided a crucial foundation for this *Austroplebeia* revision paper and his expert advice was of immense assistance.

References

1. Stories of our native bee safaris have been published in Issues 1–5, 7–16 and 18 of *Aussie Bee Bulletin*, published by the Australian Native Bee Research Centre. Four of these articles have been reprinted in Articles 16, 17, 19 and 21 of *Aussie Bee Online*: www.aussiebee.com.au/abol-current.html

2. Dollin, AE, Dollin, LJ and Sakagami SF (1997) Australian stingless bees of the genus *Trigona* (Hymenoptera: Apidae). *Invertebrate Taxonomy*, 11: 861–896.

3. Dollin, AE, Dollin, LJ, and Rasmussen, C (2015) Australian and New Guinean stingless bees of the genus *Austroplebeia* (Hymenoptera: Apidae)—a revision. *Zootaxa*, 4047: 1–73. www.mapress.com/zootaxa/list/2015/4047(1).html

4. Dollin, AE (2010) How to recognise the different types of Australian stingless bees. *Native bees of Australia Series*. Booklet 4. Australian Native Bee Research Centre.

5. Halcroft, MT, Dollin, A, Francoy, TM, King, JE, Riegler, M, Haigh, AM and Spooner-Hart, RN (2015) Delimiting the species within the genus *Austroplebeia*, an Australian stingless bee, using multiple methodologies. *Apidologie*, DOI 10.1007/s13592-015-0377-7.

6. Michener, CD (1961) Observations on the nests and behaviour of *Trigona* in Australia and New Guinea (Hymenoptera, Apidae). *American Museum Novitates*, 2026: 1–46.

7. Cockerell, TDA (1930) The bees of Australia. *Australian Zoologist*, 6: 137–156.

Some of the images reproduced on pages 1–2, 5–6, 9–12 and 14–19 were first published in Zootaxa, 4047: 1–73.